Purpose: To characterize the photon spectrum from a Theratronics T1000 cobalt-60 teletherapy unit using Compton spectrometry and compare to primary beam measurement and Monte Carlo (MC) simulation.

Methods: A well-shielded high-purity germanium detector was used to measure the photon spectrum scattered at 22.5 and 70 degrees from the central axis of a 10cmx10cm beam of a cobalt-60 teletherapy unit. The central-axis photons were scattered using an aluminum rod (6mm diameter) positioned 100cm from the source, and the scattered photons were admitted to the detector through a 30cm-long collimating aperture (2mm diameter). The measured Compton-scattered spectra were corrected for detector response, determined using a model of the measurement apparatus in the MCNP5 MC code, and Compton relations (energy-angle and Klein-Nishina) to determine the central-axis spectrum at 100cm from the source. The primary photon spectrum was measured with the collimating aperture aligned to the central axis and corrected for detector response. A MC model of the cobalt-60 unit was developed in MCNP5 and used to generate the central-axis spectrum for a 10cmx10cm field.

Results: The primary photon peaks from the cobalt-60 source were appropriately shifted to lower energies in the Compton-scattered spectra. The resolution of the shifted peaks degraded with increasing scattering angle. The corrected scattered spectra compared well with the primary measurement and MC simulation for peak position, but disagreed in the lower-energy continuum where source and collimator scatter are present. Differences are likely due to resolution loss with scattering and incomplete measurement correction.

Conclusions: The spectrum from a cobalt-60 teletherapy unit was measured using Compton spectrometry. This spectrum was compared to direct measurement and MC simulation of the unit. Results indicate that small scattering angles should be used with this measurement technique and that further work is required to reconcile differences between measurements and simulations for source and collimator scatter.